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APPRENTICESHIP TRAINING

ELECTRICAL REWIND MECHANIC Program



MANPOWER
Apprenticeship and Trade Certification

DDN 5711418



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ELECTRICAL REWIND MECHANIC TRADE

THE GOAL OF APPRENTICESHIP TRAINING

To develop a competent tradesman who, through skill and knowledge, is capable of fault finding, repairing or rebuilding and testing out electrical equipment including motors, generators, transformers and control equipment.

THE PRODUCT OF APPRENTICESHIP — a graduate who will:

- ★ Understand the principles of sound and safe trade practices.
- ★ Interpret drawings, plans and be able to layout and develop projects according to specifications.
- ★ Use the tools of the trade in a safe and proper manner.
- ★ Relate to the work of other tradesmen employed in industry either on construction or in maintenance.
- ★ Perform assigned tasks in accordance with quality and production standards required in industry.

ELECTRICAL REWIND MECHANIC APPRENTICESHIP INFORMATION

Basic Requirements:

- ★ Indenture for four periods of Trade experience.
- ★ Attend an eight week technical training course in the first, second, third and fourth periods.
- ★ Fulfill the requirements for each period including 1800 hours of work experience inclusive of time spent at the training course; successfully complete the technical training course and obtain a satisfactory employer's report.
- ★ Education — a minimum requirement is the completion of grade 10 with Mathematics 10 or its equivalent or a pass on an equivalent entrance examination as prescribed by the Trade regulation.
- ★ Age — the minimum age for apprentices is 16 years. There is no upper age limit.

Credits:

- ★ Accelerated patterns of apprenticeship may be granted for related technical training and/or experience.

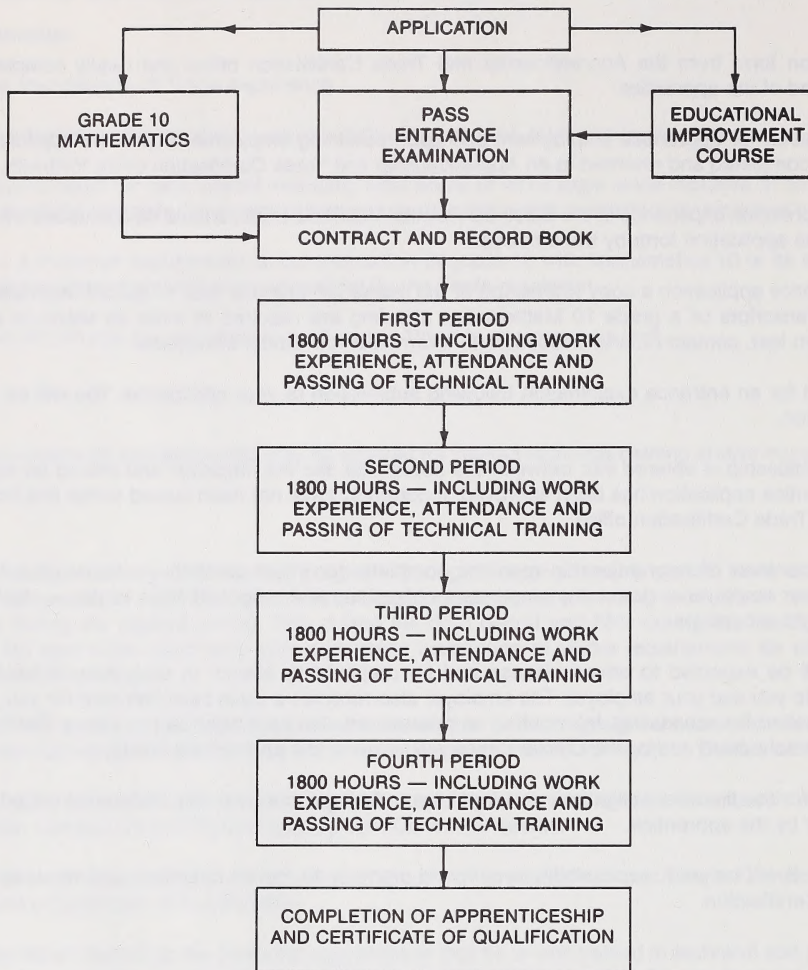
Benefits:

- ★ Apprenticeship is a learning-while-earning program. During the apprenticeship period, while working at the trade, apprentices are assured by regulation of a minimum percentage of the prevailing journeyman rate: 55% during the first period, 65% during the second period, 75% during the third period and 85% during the fourth period. Progress from one rate to the next takes place only after successful completion of all the requirements for each period. (details are outlined in the Record Book).
- ★ All apprentices 17 years of age and older are normally eligible for training allowances while attending technical training courses. These allowances are funded by the Canada Employment and Immigration Commission.
- ★ Administrative procedures establishing the amount of training allowance is complex and can vary with an individual's circumstances. Contact a local Canada Employment Centre for details.
- ★ An apprentice who successfully completes the program will graduate with an Alberta Completion of Apprenticeship Certificate and a Certificate of Qualification.
- ★ The most significant benefit to the graduate apprentice is that he is well trained in technical and practical aspects of the trade and is able to make a worthwhile and productive contribution to society. Society in return, will provide an opportunity for livelihood.

DIRECTIONS FOR PROSPECTIVE APPRENTICES

- ★ Contact your nearest Apprenticeship and Trade Certification office for detailed information and counselling (see list of offices on page 26).
- ★ Obtain an application form from the Apprenticeship and Trade Certification office and neatly complete, in full, the information requested of the apprentice.
- ★ Persevere in the search for apprentice employment and upon obtaining employment, give the application to the employer. It should be completed and returned to an Apprenticeship and Trade Certification office forthwith.
- ★ Any time credit, for previous experience in the Electrical Rewind Mechanic trade, should be discussed with the employer and requested on the application form by the employer.
- ★ Attach to the apprentice application a copy (transcript) of the marks for your last year of school. Applicants who do not have their school transcripts or a grade 10 Mathematics standing are required to write an entrance examination. If transcripts have been lost, contact Alberta Education for information on school transcripts.
- ★ Prepare to be called for an entrance examination following submission of your application. You will be advised of the date, time and location.
- ★ A contract of apprenticeship is entered into between the apprentice and the employer and should be signed within 90 days after the apprentice application has been approved. If contracts have not been issued within this time, contact the Apprenticeship and Trade Certification office.
- ★ Before signing the contract of apprenticeship read the complete document carefully — know your obligations and responsibilities to your employer — know the employer's obligations and responsibilities to you — feel confident you have selected the right occupation.
- ★ Know when you will be expected to attend classes and be prepared to attend. In early May of each year, School Schedules are sent to you and your employer. The employer also receives a class selection card for you, which is to be completed and submitted for scheduling. Information on procedures also accompanies the above. Confirmation on the date you actually get scheduled and/or the Official Notice will follow at the appropriate time(s).
- ★ Prepare in advance for the financial obligations required of you during school training. Reference materials and school supplies are paid for by the apprentice.
- ★ While an apprentice, it will be your responsibility to respond promptly to mailed directions and requests from Apprenticeship and Trade Certification.

APPRENTICESHIP ROUTE TOWARD CERTIFICATION



APPRENTICESHIP COMMITTEE STRUCTURE

Electrical Rewind Mechanic Provincial Apprenticeship Committee

The Provincial Apprenticeship Committee for the Electrical Rewind Mechanic Trade is comprised of members from Local Apprenticeship Committees from the cities of Edmonton and Calgary.

This Committee is concerned with the policies that guide the program and make recommendations to the Apprenticeship and Trade Certification Board and the Executive Director of Apprenticeship and Trade Certification in the following areas:

- ★ Contribute current information relative to changes in the trade and requirements of industry.
- ★ Make recommendations for changes to existing trade regulations.
- ★ Assist in updating of the training program through recommendations for revisions to the course outline and attendant examinations.

Electrical Rewind Mechanic Local Apprenticeship Committee

Local Apprenticeship Committees are concerned with individuals and trade situations within a local region. Meetings are held throughout the year to make recommendations and to discuss problems relating to the apprenticeship program. Members who serve on committees are nominated by employer and labour organizations, and membership is equally divided into employer and employee representation in accordance with The Manpower Development Act.

Apprenticeship Committee Members:

Mr. A. Young — Edmonton — Employer
Mr. J. Oliver — Edmonton — Employer
Mr. G. Clarke — Edmonton — Employee
Mr. W. Georg — Edmonton — Employee
Mr. D. James — Calgary — Employer
Mr. Z. Piebiak — Calgary — Employer
Mr. D. Palmer — Calgary — Employee
Mr. P. Nielson — Calgary — Employee
Mr. W. Marshall — Edmonton — Employer (Alternate)
Mr. P. Zahacy — Edmonton — Employee (Alternate)
Mr. C. Cobb — Calgary — Employer (Alternate)
Mr. R. Kubota — Calgary — Employee (Alternate)

ELECTRICAL REWIND MECHANIC PROGRAM COURSE OUTLINE

This outline has been prepared in accordance with recommendations from the Provincial Apprenticeship Committee for the Electrical Rewind Mechanic Trade in the Province of Alberta.

The outline was updated following consideration given to recommendations and suggestions from:

- Local Apprenticeship Committees
- Representatives from training institutes
- Curriculum Sub-Committee from the Provincial Apprenticeship Committee

PROCEDURES FOR RECOMMENDING REVISION(S) TO THE COURSE OUTLINE

Any concerned citizen or group in the Province of Alberta may make recommendations for change by writing to the Apprenticeship and Trade Certification, Edmonton.

It is requested that recommendations for change refer to specific areas and state references used. Recommendations received will be placed before regular meetings of the Provincial Apprenticeship Committee.

SAFETY EDUCATION

Safe working procedures and conditions, accident prevention and the preservation of health is of primary importance in the Apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of the government, employers, employees and the general public. Therefore, it is imperative that all parties become aware of circumstances that may lead to injury or harm and that safe learning experiences and environment can be created by controlling the variables and behaviors that may contribute to or cause an accident and/or an injury.

It is generally recognized that a safe attitude contributes to an accident free environment. As a result a healthy safe attitude towards accidents will benefit an employee by helping to avoid injury, loss of time and loss of pay.

A tradesman is possibly exposed to more hazards than any other person in the work force and therefore, should be familiar with the Occupational Health and Safety Act and Regulations dealing with his own personal safety and the special safety rules applying to each job.

LEGAL AND ADMINISTRATIVE ASPECTS

Employer's Responsibilities:

Accident prevention and the provisions of safe working conditions are the responsibilities of an employer. The company is responsible for:

1. The provision and maintenance of safety equipment
2. The provision of protective devices and clothing (as required by the Occupational Health & Safety Act, General Safety Regulations)
3. The enforcement of safe working procedures
4. Adequate safeguards for machinery, equipment and tools
5. Observance of all accident prevention regulations
6. Adequate training to allow a worker to use or operate equipment in an effective and safe manner.

Government's Responsibilities:

Apprenticeship and Trade Certification in conjunction with the respective Provincial Apprenticeship Committee assumes the responsibility to assure that adequate safety is reflected in the curriculum and that adequate safety instruction is presented at the training establishments.

The Occupational Health and Safety Inspection Branch assumes the responsibility for periodic inspection of the operation to ensure that regulations for industry are being correctly observed.

Individual's Responsibilities:

The employee is responsible for:

1. Knowing and working in accordance with the safety regulations pertaining to job environment and
2. Working in such a way as not to endanger himself or his fellow employees

The major factor in safety is the individual employee, his personal attitude toward safety and having an awareness of the respective safety regulation.

ELECTRICAL REWIND MECHANIC PROGRAM

Subjects	Time Distribution in Hours				Totals
	First Period	Second Period	Third Period	Fourth Period	
Principles of Electricity	73	81	89	23	266
Magnetism	12				12
Electrical Measuring Devices	20				20
Mathematics	10				10
SI System	2				2
Tools of the Trade	40				40
Machine Components	6				6
Machine Installations	10				10
Switching Circuits	12				12
Repair and Rewinding	32	60	86	50	228
Transformers		16	12		28
Single Phase Motors		12	12		24
Magnetic Switches and Control Circuits		28			28
Phase Converters				6	6
Three Phase Motor Starters & Controllers			12	31	43
Synchronous Machines				36	36
Industrial Electronics				40	40
Trouble Shooting				6	6
Electric Welders				6	6
Safety and Regulations	6	16	2	4	28
Rigging and Hoisting	2				2
Power Measurement				6	6
Static and Dynamic Balancing				3	3
Programmable Controllers				2	2
Review		12	12	12	36
Administration and Examinations	15	15	15	15	60

First Period: 8 Weeks at 30 Hours Per Week for 240 Hours

Second Period: 8 Weeks at 30 Hours Per Week for 240 Hours

Third Period: 8 Weeks at 30 Hours Per Week for 240 Hours

Fourth Period: 8 Weeks at 30 Hours Per Week for 240 Hours

FIRST PERIOD TECHNICAL TRAINING ELECTRICAL REWIND MECHANIC TRADE COURSE OUTLINE

TOPIC

COURSE OBJECTIVES

Upon completion of the unit, the apprentice should be able to:

A. Principles of Electricity

73 Hours

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Structure of Matter 2. Electron Theory 3. Generation of E.M.F. 4. Electrical Units 5. Ohm's Law 6. Electrical Circuits <ol style="list-style-type: none"> (a) series (b) parallel (c) Kirchoff Laws (d) three wire Edison Circuit <ol style="list-style-type: none"> (i) balanced (ii) unbalanced (iii) open neutral (e) line loss (f) voltage drop 7. Conductors <ol style="list-style-type: none"> (a) copper (b) aluminum 8. Insulators 9. Semi-conductors 10. Power <ol style="list-style-type: none"> (a) mechanical (b) electrical (c) work (d) energy 11. Torque 12. Alternating Current <ol style="list-style-type: none"> (a) sine waves (b) phasors | <ol style="list-style-type: none"> 1. Explain the fundamental relationship between the structure of the atom and flow of electrons. 1. Understand the methods used to generate AC and DC. 2. Describe the relationship between cycles, poles and frequency. 1. Define quantity express symbols and units of measurement for the units of measurement for the following electrical terms: <ol style="list-style-type: none"> (a) Volts (b) Amperes (c) Ohms (d) Watts (e) Watthours (f) Coulombs (g) Joules 1. Describe the relationship of voltage, current and resistance in an electric circuit. 2. Solve problems using Ohm's Law. 3. Connect circuits and make voltage, current and resistance measurements to verify Ohm's Law. 1. Analyze and explain series, parallel and Edison three wire circuits and identify their applications. 2. Apply Kirchoff's current and voltage laws to circuit. 3. Solve problems involving series, parallel and Edison three wire circuits (balanced and unbalanced). 4. Define and calculate line loss and voltage drop of a simple motor-generator feeder system. 5. Connect and take measurements of series and parallel circuits using schematic and wiring diagrams to verify Ohm's Law. 1. Define conductor with reference to electricity. 2. Define resistivity. 3. Recognize wire sizes (AWG or SI). 4. Calculate temperature coefficient of resistance. 1. Define insulators with reference to electricity. 1. Define semi-conductors with reference to electricity. 1. Define work, energy and power. 2. State the units of work, energy and power. 3. Calculate electrical power. 4. Calculate mechanical power and work. 5. Convert horsepower to watts. 1. Define torque. 2. Calculate measurement of torque (Prony Brake). 1. Define instantaneous value. 2. Define RMS or effective value. 3. Define maximum or peak value. 4. Illustrate in phasors analysis directions and magnitude of phasors. |
|---|---|

5. Define:
 - (a) vector
 - (b) phase
 - (c) lead
 - (d) lag
 - (e) cycle
 - (f) angles in electrical degrees

B. Magnetism**12 Hours**

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Magnetic Fields and Lines of Force 2. Magnetic attraction and Repulsion 3. Electromagnetic Induction 4. Self-Induction 5. Mutual Induction | <ol style="list-style-type: none"> 1. Describe the characteristics of magnetic lines of force. 1. State the laws of magnetic attraction and repulsion. 2. Describe the field around a current carrying conductor. 1. Describe the electromagnetism. 2. State Faraday's law of induction. 3. State Lenz's law of induction. 4. State Fleming's hand rule for generator action. 1. Describe self-induction in a coil. 1. Outline the relationship between current and magnetism to explain transformer action. |
|---|---|

C. Electrical Measuring Devices**20 Hours**

- | | |
|---|---|
| <ol style="list-style-type: none"> 1. Galvanometer 2. Types of Meters 3. Use, Care and Safety of Meters 4. Shunts and Multipliers 5. Growler | <ol style="list-style-type: none"> 1. Understand the principle of meter movements. 1. Describe the principle of operation and an application of: <ol style="list-style-type: none"> (a) D'Arsonval (b) iron vane (c) electro-dynamometer 1. Describe the proper care and safety precautions for: <ol style="list-style-type: none"> (a) ammeters (b) voltmeters (c) ohmmeters (d) meggers (e) wattmeters (f) multimeters (g) high potential insulation testing (h) growlers 2. Demonstrate proper scale range selection and wiring connections. 3. Demonstrate accurate measurements. 1. Calculate using correct shunts or multipliers. 1. Use a growler to test for shorts, opens and ground faults. |
|---|---|

D. Mathematics**10 Hours**

- | | |
|--|--|
| <ol style="list-style-type: none"> 1. Addition, Subtraction, Multiplication and Division
(with or without calculators) 2. Square Root 3. Ratio and Proportion 4. Percentages 5. Algebraic Equations | <ol style="list-style-type: none"> 1. Display the ability to do addition, subtraction, multiplication and division of: <ol style="list-style-type: none"> (a) whole numbers (b) decimals (c) fractions (d) signed numbers (e) exponents 1. Solve problems involving square root. 1. Solve problems involving ratio and proportions. 1. Solve problems involving percentages. 1. Transpose simple algebraic equations. |
|--|--|

TOPIC

COURSE OBJECTIVES

6. Trigonometric Functions
7. Phasors (Vectors)
8. Reciprocals
9. Graphs

1. Solve right angle triangles using trigonometric functions given unknowns.
1. Solve problems involving magnitude and directions.
1. Understand their usage in electrical problems.
1. Display the ability to interpret information from graphs.
2. Demonstrate plotting principles.

E. SI Systems

2 Hours

1. Solve problems using SI for:
 - (a) linear
 - (b) area
 - (c) volume
 - (d) weight
 - (e) temperature

F. Tools of the Trade

40 Hours

1. Hand Tools

1. Identify and describe the correct and safe use of hand tools related to this trade, namely:
 - (a) hacksaws
 - (b) drill bits
 - (c) tap and dies
 - (d) files
 - (e) wire gauge
 - (f) dial gauge
 - (g) micrometer
 - (h) calipers
 - (i) crimping tools
 - (j) wire skinners
 - (k) scales
 - (l) screw drivers
 - (m) punches
 - (n) chisels
 - (o) pliers
 - (p) wrenches
 - (q) reamers
 - (r) screw extractors
 - (s) soldering irons
 - (t) torches

2. Identify and describe the correct and safe use of measuring tools for various applications.

3. Demonstrate the correct care and maintenance of all hand tools.

2. Power Tools

1. Identify and describe the correct and safe use of power tools, including:
 - (a) bench grinder
 - (b) pedestal grinder
 - (c) hand grinders
 - (d) press drill
 - (e) hydraulic press
2. Demonstrate the correct procedures for:
 - (a) dressing and truing grinding wheels
 - (b) grinding lathe tools
 - (c) grinding twist drills
 - (d) dressing chisels, screwdrivers, etc.

3. Describe the proper types and uses of grinding wheels.

4. Explain the correct storage of grinding wheels.

5. Demonstrate the safe use of power tools.

3. Shop Tools

1. Identify and describe the correct use and maintenance of an engine lathe.
2. Describe the correct safety protection required when using a lathe.
3. Demonstrate the following tasks on a lathe:

- (a) centre drilling
- (b) chucking an armature
- (c) coil winding
- (d) turning and undercutting a commutator

4. Soldering

1. Demonstrate the proper technique of using soldering irons or torches.

5. Brazing

1. Demonstrate the proper technique of silver brazing.

G. Machine Components

6 Hours

1. Types of Bearings

1. Describe the types and uses of bearings, including:
 - (a) friction (bushing)
 - (b) anti-friction
 - (i) regular
 - (ii) angle

2. Bearing Installation

1. Demonstrate the installation of various bearings.
2. Check shafts before bearing installation for:
 - (a) diameter
 - (b) loudness
 - (c) damage
3. Remove various bearings by using one or more of the following methods:
 - (a) press removal
 - (b) bearing splitter
 - (c) inside puller

3. Type of Seals

4. Proper use of bearing heaters
1. Describe the types:
 - (a) dynamic
 - (b) static
 - (c) balanced
2. Describe the use of the following seals:
 - (a) external
 - (i) positive
 - (ii) non-positive
 - (b) internal
 - (i) positive
 - (ii) non-positive
 - (c) gaskets

4. Seal Installation

1. Describe installation of gaskets and seals, including:
 - (a) O rings
 - (b) U section rings
 - (c) V packing
 - (d) cup packing
 - (e) piston ring
 - (f) lip seal

H. Machine Installation

10 Hours

1. Alignment

1. Describe and demonstrate the general alignment of motors in line with other equipment, including:
 - (a) flat belt
 - (b) v-belt
 - (c) chain
 - (d) gear train
 - (e) coupling
2. Describe the levelling of motors including the use of shims and/or jacking screws.
3. Calculate speeds, using:
 - (a) belts
 - (b) pulleys
 - (c) gears

I. Switching Circuits

12 Hours

1. Demonstrate and draw schematics for:
 - (a) single and multiple pole switches
 - (b) single and multiple throw switches
 - (c) multiposition switch
 - (d) rotary switches
 - (e) push button switches
 - (f) three-way switches
 - (g) four-way switches
2. Describe the operating principle of a relay.
3. Identify the parts of a relay.
4. Identify and describe limit switches.
5. Draw schematic and wiring diagrams and connect relay circuits for NO and NC contacts.

J. Repair and Rewinding

32 Hours

1. Induction Motors

1. Dismantle and identify all parts.
2. Strip and record all winding data.
3. Clean and insulate all slots.
4. Wind and replace all coils.
5. Connect and secure all coils.
6. Explain the method of dipping and baking and demonstrate reassemble.
7. Replace starting switches, centrifugal mechanisms and built-in devices.

K. Safety and Regulations

6 Hours

1. Occupational Health and Safety
 (a) Act
 (b) Regulations

1. Demonstrate an ability to locate and interpret major sections of the OHS Act.
2. Demonstrate an ability to locate and interpret sections of the General Safety Regulations.
3. Demonstrate an ability to locate and interpret Serious Injury Accident, Noise and First Aid Regulations.

2. Workers' Compensation Act

1. Define the principle of Workers' Compensation.

3. Manpower Development Act
 (a) General Regulations
 (b) Trade Regulations

1. State the terms of apprenticeship.
2. Understand apprenticeship route towards certification.

4. Shop Safety

1. Demonstrate the safe use of tools protective equipment.
2. Describe various hazards of the trade and measures to safeguard against them.

L. Rigging and Hoisting

2 Hours

1. Describe the effect that sling angles have in safe lifting, including:
 - (a) critical angle of slings
 - (b) load limits
 - (c) shock loading
2. Describe basic OHS hand signals for hoisting.
3. Identify the mechanical advantages of single and multiple sheave rigging configurations.

**SECOND PERIOD TECHNICAL TRAINING
ELECTRICAL REWIND MECHANIC TRADE
COURSE OUTLINE**

TOPIC

COURSE OBJECTIVES

Upon completion of the unit, the apprentice should be able to:

A. Principles of Electricity

81 Hours

1. DC Machines
 - (a) Generators
 - (b) Motors

1. Name the parts of the magnetic circuit of a DC machine, including:
 - (a) field yoke
 - (b) Pole cores
 - (c) armature core
 - (d) end bells
 - (f) air gaps
2. List and explain the following pieces of information found on a DC motor generator's name plate, including:
 - (a) rpm
 - (b) volts (armature and field)
 - (c) output
 - (i) kW
 - (ii) HP
 - (d) current (armature and field)
 - (e) temperature rise
3. Name the parts of the electrical circuit of a DC machine, including:
 - (a) armature winding
 - (b) commutator
 - (c) brushes
 - (d) field windings
 - (e) interpoles
 - (f) brush holders
4. Explain the characteristics and demonstrate the different methods of field excitation, including:
 - (a) separate
 - (b) series
 - (c) shunt
 - (d) compound
5. Understand the principles and characteristics of voltage regulations of a DC generator.
6. Calculate the efficiency of a DC generator.
7. State the DC motor principle.
8. Understand and demonstrate the methods of starting and speed control of a DC motors.
9. Understand Dynamic Braking of a DC motor.
10. Explain and demonstrate the different connections and methods of reversing direction of a DC motor.
11. Apply different methods of trouble shooting DC machines.

2. Alternating Current
 - (a) Sine waves
 - (b) Phasors

1. Explain instantaneous value.
2. Explain RMS or effective value.
3. Explain maximum or peak value.
4. Illustrate in phasor analysis directions and magnitude of phasors.
5. Define:
 - (a) phasors (vectors)
 - (b) phase
 - (c) lead
 - (d) lag
 - (e) cycle
 - (f) angles of degrees
 - (i) electrical
 - (ii) mechanical

TOPIC

COURSE OBJECTIVES

3. Inductance and Inductive Reactance

1. Describe inductance and the factors which affect inductance.
2. Describe induction and its effects.
3. Describe the DC inductive effects.
4. Describe the AC inductive effects.
5. Define inductance and state its symbol.
6. State the unit of measurement for inductance and its symbol.
7. Define inductive reactance and state its symbol.
8. State the unit of measurement for inductive reactance and its symbol.
9. Calculate the total inductance when inductors are connected in series or parallel.
10. State Faraday's law.
11. State Lenz's law.
12. Solve problems involving series and parallel circuits with all possible combinations of resistance.
13. Define time constant for RL circuit.

4. Capacitance and Capacitive Reactance

1. Describe the construction and characteristics of an elementary capacitor.
2. Describe capacitance and the factors which affect it.
3. Describe capacitor types and applications.
4. Calculate the value of a time constant for an RC circuit.
5. Explain AC capacitive effects.
6. State the unit of measurement for the charge of a capacitor and give its symbol.
7. Define dielectric strength.
8. Define capacitance.
9. State the unit measurement for capacitance.
10. Define capacitive reactance.
11. Give the symbol for capacitive reactance and state its unit of measurement.
12. Explain the equation for capacitive reactance.
13. State the phase relationship between voltage and current in a capacitive circuit.
14. Calculate the total capacitance for capacitors in series or parallel.
15. Calculate the capacitive reactance of any given circuit.
16. Solve problems involving resonance.

5. Single Phase Circuits

1. Define impedance.
2. State the unit of measure for impedance.
3. State the components of an impedance triangle.
4. Define power and give its symbol.
5. State the unit of measurement for power and give its symbol and unit of measurement.
6. Define apparent power and give its symbol.
7. State the unit of measurement for apparent power and give its symbol and unit of measurement.
8. Define reactive power and give its symbol.
9. State the unit of measurement for reactive power and give its symbol and unit of measurement.
10. Define power factor.
11. Define phase angle and give its symbol.
12. Calculate:
 - (a) impedance

- (b) current
- (c) voltage
- (d) voltage drops
- (e) apparent power
- (f) total power
- (g) power factor
- (h) power factor correction

13. Draw phasor diagrams for various types of circuits.

6. Three Phase Systems

- 1. Explain the generation of three phase voltages.
- 2. State the advantages for three phase systems over single phase systems.
- 3. Name the types of three phase connections.
- 4. Define the term balanced three phase system.
- 5. State the phase relationship for the 3 voltages in a three phase system.
- 6. State and demonstrate by phasor analysis the relationship between E_{phase} and E_{line} for a wye system.
- 7. State and demonstrate by phasor analysis the relationship between E_{phase} and E_{line} for a delta system.
- 8. State and demonstrate by phasor analysis the relationship I_{phase} and I_{line} for a wye system.
- 9. State and demonstrate by phasor analysis the relationship between I_{phase} and I_{line} for a balanced delta system.

B. Repair and Rewinding

60 Hours

- 1. DC Machines
 - (a) Generators
 - (b) Motors

- 1. Demonstrate stripping.
- 2. Display the ability to record data.
- 3. Demonstrate insulating.
- 4. Demonstrate rewinding.
- 5. Turn and under cut a commutator.
- 6. Demonstrate armature banding.

2. Insulation

- 1. Describe the types used.
- 2. Know the different classes and uses.

3. DC Armature Coil

- 1. Wind and tape a small armature coil.
- 2. Explain the purpose of dipping and baking.

4. DC Field Coil

- 1. Form, wind, tape and shape a field coil.
- 2. Explain the purpose of dipping and baking.

C. Transformers

16 Hours

1. Types

- 1. State the different types, including:
 - (a) power
 - (b) distribution
 - (c) instrument
 - (d) isolating

2. Construction and Nameplate Data

- 1. Describe the basic components of a transformer and the nameplate information.
- 2. List the purposes of a transformer.
- 3. Identify primary and secondary of a transformer.
- 4. Differentiate between a step-up and a step-down transformer.
- 5. Explain the standard terminal and winding identification.

3. Operating Principles

- 1. Describe transformers action.
- 2. Describe the operation of a transformer as load is added.
- 3. Understand the losses that occur.

TOPIC**COURSE OBJECTIVES**

4. Rating and Ratio	<ol style="list-style-type: none">1. State how transformers are rated and sized.2. Describe and solve problems involving transformers voltage, turns and current ratios.3. Explain the reason why transformers are rated in voltage and volt-amps.
5. Polarities	<ol style="list-style-type: none">1. Differentiate between subtractive and additive polarity.
6. Cooling Methods	<ol style="list-style-type: none">1. Describe the various methods of cooling for transformers.2. Identify liquids used for cooling.
7. Operation of Instrument Transformers (single phase)	<ol style="list-style-type: none">1. Describe the function of current and voltage transformers.2. Calculate wattmeter readings.
D. Single Phase Motors	12 Hours
1. Single Phase Motors	<ol style="list-style-type: none">1. Understand the principles, characteristics and applications of single phase motors, namely:<ol style="list-style-type: none">(a) series (Universal)(b) split phase(c) capacitor<ol style="list-style-type: none">(i) capacitor start(ii) permanent-split-capacitor(iii) two value capacitor(d) shaded pole(e) synchronous(f) repulsion-induction2. Demonstrate connections and draw diagrams for:<ol style="list-style-type: none">(a) single and dual voltage(b) multiple speed(c) reversing(d) current and voltage starting relays3. Explain protective devices, including:<ol style="list-style-type: none">(a) built in thermal(b) current relays(c) overload relays4. Demonstrate winding techniques,
E. Magnetic Switching and Control Circuits 28 Hours	
1. Relays	<ol style="list-style-type: none">1. Understand and be able to explain relays, including:<ol style="list-style-type: none">(a) construction(b) operation and connection(c) nameplate data(d) types<ol style="list-style-type: none">(i) single contact(ii) multi-contact(iii) enclosed and open contact(iv) plug in bases(v) latching mechanical reset(vi) latching electrical reset
2. Magnetic Switches	<ol style="list-style-type: none">1. Explain the application of relays to magnetic switches.2. Explain the principle of a magnetic switch.3. Understand the operation of the components of a magnetic switch.4. Demonstrate the ability to maintain magnetic switches.
3. Contacts	<ol style="list-style-type: none">1. Identify different contacts used in magnetic switches, including:<ol style="list-style-type: none">(a) copper(b) silver(c) weld resistant alloys
4. Pilot Circuit Devices	<ol style="list-style-type: none">1. Recognize and explain the use of the following devices and their symbols:<ol style="list-style-type: none">(a) momentary contact

- (b) maintained contact
- (c) push button start-stop station
- (d) float switches
 - (i) mechanical
 - (ii) bulb
 - (iii) capacitive probe
- (e) pressure switches
- (f) limit switches
 - (i) mechanical
 - (ii) proximity

5. Circuits and Connections

1. Understand and demonstrate control circuits containing:
 - (a) start-stop stations
 - (b) start-jog-stop stations
 - (c) forward-reverse-stop stations
 - (d) electrical interlocking
 - (e) mechanical interlocking
 - (f) push button interlocking
2. Develop schematic and wiring diagrams.
3. Interpret shop drawings and circuit diagrams.

F. Safety and Regulations

16 Hours

1. Canadian Electrical Code Part I

1. Interpret safety standards provided in the Canadian Electrical Code from either section 0, 10 or 28.

**THIRD PERIOD TECHNICAL TRAINING
ELECTRICAL REWIND MECHANIC TRADE
COURSE OUTLINE**

TOPIC

COURSE OBJECTIVES

Upon completion of the unit, the apprentice should be able to:

A. Principles of Electricity

89 Hours

1. Three Phase Motors

1. Explain the main types of three phase motors, including:
 - (a) squirrel cage
 - (b) wound rotor
 - (c) synchronous
2. State the functions of the principle parts of the squirrel cage induction motor, including:
 - (a) stator
 - (b) rotor
 - (c) end bells and bearings
3. Explain the principle of operation of a:
 - (a) squirrel cage
 - (b) wound rotor
4. Demonstrate a rotating magnetic field.
5. Explain rotor frequency, slip, poles and RPM relationship.
6. Explain regulation and efficiency.

2. Rotors

1. Explain squirrel cage rotor types and designs (EEMAC).
2. State effect of rotor resistance on starting torque and starting current.
3. Describe regulation and efficiency.
4. Explain the principle of a wound rotor motor.

3. Multispeed Motors

1. Explain multispeed motors using separate windings for each speed, including:
 - (a) possible speed combinations
 - (b) winding pitch
 - (c) coil grouping
 - (d) wire sizes
 - (e) connections
 - (f) insulation requirements
2. Understand multispeed motors using distributed, salient and consequent pole configurations, including:
 - (a) development of consequent poles
 - (b) speed relations
 - (c) typical connections
 - (d) connection schematics for:
 - (i) variable torque
 - (ii) constant horsepower
 - (iii) constant torque
3. Calculate voltage and frequency changes by reconnection or rewind.
4. Calculate wire size and turns required to produce similar horsepower and speed characteristics when voltage change is being carried out.
5. Calculate lower speed changes where reconnection or rewinding is necessary (eg. 1800 to 1200 RPM), including:
 - (a) grouping of coils
 - (b) connections
 - (c) wire size
 - (d) number of turns per coils
 - (e) Hp relationship

4. Torque and Speed

1. Describe the characteristics and relationships between torque, speed, voltage and horsepower of three phase induction motors.
2. Know the effect of loading on power motors.

5. Three Phase Systems

1. State and demonstrate the connections and relationships between three phase systems, including:
 - (a) wye (star)
 - (i) phase or line current
 - (ii) phase or line voltage
 - (b) delta
 - (i) phase or line current
 - (ii) phase or line voltage
2. Calculate three phase systems balanced or unbalanced pertaining to voltage and/or current.

B. Repair and Rewinding**86 Hours**

1. Three Phase Motors

1. Describe and demonstrate stripping.
2. Display the ability to record data.
3. Demonstrate insulating.
4. Demonstrate different rewinding methods including:
 - (a) series and parallel star
 - (b) series and parallel delta
 - (c) two, four, six and eight pole
 - (d) one and four connections
 - (e) one and seven connections
5. Explain coil pitch.
6. Explain coil span.
7. Explain chording and reasons for doing so.
8. Understand pole-phase groups.
9. Explain chord factor and distribution factor as well as their effects on the overall motor characteristics.
10. Draw three phase motor radial winding diagrams.
11. Explain and demonstrate turns per coil and slot fill.
12. Demonstrate:
 - (a) winding coils of different types
 - (i) formed
 - (ii) mush
 - (b) installing phase insulation
 - (c) sleeving
 - (d) making connections and attaching leads
 - (e) taping
 - (f) binding and securing winding
 - (g) testing rewound motors
 - (h) identify the leads of dual voltage and multispeed motors

2. Single Phase Motors

1. Demonstrate replacement of built-in thermal overload devices for single and dual voltage motors.
2. Demonstrate the installation and adjustment of centrifugal mechanisms and starting switches.
3. Demonstrate the installation of solid state, current and potential relays as starting switches for replacement for centrifugally operated types.
4. Demonstrate stripping.
5. Display the ability to record data.
6. Demonstrate different winding methods.
7. Draw proper radial and schematic diagrams.
8. Demonstrate the ability to test for electrical and mechanical faults.

3. Rotors

1. Demonstrate physical characteristics and EEMAC classes.
2. Diagnose rotor faults, including:
 - (a) techniques of trouble shooting using growlers and single phase excitation
 - (b) the importance of full load tests
3. Understand the methods of repairing rotors.

C. Transformers**12 Hours**

1. Connection
 1. Demonstrate ability to determine polarity.
 2. Demonstrate identification of leads.
 3. Demonstrate connections for single and three phase.
 4. Describe and demonstrate connections for autotransformers.
2. Maintenance
 1. Explain maintenance and test procedures, including oil testing.

D. Single Phase Motors**12 Hours**

1. Characteristics
 1. Demonstrate the different characteristics of single phase motors, including:
 - (a) series (universal)
 - (b) split phase
 - (c) capacitor
 - (i) capacitor start
 - (ii) permanent split capacitor
 - (iii) two value capacitor
 - (d) shaded pole
 - (e) synchronous
 - (f) repulsion — induction
 2. Demonstrate the different connection and methods of reversing.
 3. Demonstrate dynamometer tests.
 4. Describe and demonstrate brush settings and replacement where applicable.

E. Three Phase Motor Starters and Controllers**12 Hours**

1. Starters
 1. Describe the purpose and principle of starters, including:
 - (a) line
 - (i) manual
 - (ii) magnetic
 - (b) compensators
 - (c) resistance
 - (d) part winding
 - (e) wye-delta
2. Controllers
 1. Describe controllers and grids for wound rotor motors.
 2. Describe multispeed motor controller.

F. Safety and Regulations**2 Hours**

1. Canadian Electrical Code Part I
 1. Calculate the size of conductors for external connection to motors.

**FOURTH PERIOD TECHNICAL TRAINING
ELECTRICAL REWIND MECHANIC TRADE
COURSE OUTLINE**

TOPIC	COURSE OBJECTIVES
	Upon completion of the unit, the apprentice should be able to:
A. Principles of Electricity	23 Hours
1. Three Phase Systems	1. Calculate three phase systems balanced or unbalanced pertaining to voltage and/or current.
B. Repair and Rewinding	50 Hours
1. Explosion-Proof Motors	1. Demonstrate the techniques of handling. 2. Demonstrate the correct method of disassembly. 3. Display rewinding techniques. 4. Explain and demonstrate correct method of bringing out leads and reassembly.
2. Armatures	1. Describe commutator maintenance, including: (a) connections (b) cleaning (c) soldering (d) rebuilding (e) welding (TIG) 2. Demonstrate winding, including: (a) lap (b) wave (c) progressive (d) retrogressive 3. State test procedures: (a) surge comparison test (b) drop test 4. Describe armature banding: (a) methods (b) materials
3. Multi-Rated Motors	1. Demonstrate the knowledge of all methods of connection and tests. 2. Identify and demonstrate the ability to make connections for unmarked motor leads (external).
C. Phase Converters	6 Hours
	1. Explain the principle of operation and connection. 2. Describe the various types.
D. Three Phase Motor Starters and Controllers	31 Hours
1. Starters	1. Demonstrate the operation of different starters, including: (a) line (i) manual (ii) magnetic (b) compensators (c) resistance (d) part winding (e) wye-delta
2. Controllers	1. Demonstrate controllers and grids for wound rotor motors. 2. Demonstrate the operation of multi-speed motor controllers.
3. Variable Speed Drives	1. Describe the different types and advantages to variable speed drive systems.

40 Hours

2. Alternators

1. Name the parts of a synchronous motor.
2. List and explain the information found on the motors nameplate.
3. Describe the applications of a synchronous motor.
4. Explain the principle of operation.
5. Describe the methods of starting, including:
 - (a) manual
 - (b) automatic with build in protection
6. Explain the effects of changing loads or excitation.

1. Name the parts of a synchronous alternator.
2. List and explain the information found on the nameplate of an alternator.
3. Explain the principle of operation.
4. Describe and demonstrate paralleling and parallel operation.
5. Explain regulation and factors affecting regulation.

F. Industrial Electronics

- ## 1. Diodes

1. Understand the atomic structure of semi-conductors.
2. Explain the composition and types of diodes, including:
 - (a) PN Junction
 - (i) forward bias
 - (ii) reverse bias
 - (b) zener
 - (c) light emitting diodes
3. Describe the characteristics of diodes.
4. Explain different applications of diodes, including:
 - (a) as a switch
 - (b) as a relay
 - (c) rectifiers
 - (i) single phase
 - (ii) three phase

- ## 2. Resistors

1. Describe the different types and uses of resistors, including:
 - (a) current limit
 - (b) voltage drop
 - (c) voltage dividing
 - (d) heating
2. Explain the construction of different types, including:
 - (a) composition
 - (b) film
 - (c) wire wound
3. State the resistor colour code.

- ### 3. Bipolar Junction Transistors (BJT)

1. Define the following terms as applied to transistors:
 - (a) emitter
 - (b) collector
 - (c) base
2. Explain the composition of a transistor.
3. Describe the theory and operation of a BJT.
4. Explain different applications of BJT's, including:
 - (a) a switch
 - (b) an amplifier
 - (c) a variable resistance

- #### 4. Unijunction Transistor (UJT)

1. Explain the composition of a UJT.
2. Describe the theory and application of a UJT.

TOPIC

COURSE OBJECTIVES

5. Thyristors

- (a) SCR
- (b) Triac
- (c) Diac

1. Explain the principles of operation.
2. Explain the composition and types, including:
 - (a) 4 layer
 - (b) 5 layer
 - (c) unidirectional
 - (d) bi-directional
3. Explain operating characteristics.
4. Describe an application.
5. Describe protection for thyristors, including:
 - (a) heatsinking
 - (b) overcurrent

6. Practical Circuits

1. Demonstrate the application of components in circuits, examples:
 - (a) lamp dimmer
 - (b) universal motor speed control
 - (c) flasher
 - (d) controlled battery charger
 - (e) fan motor control
2. Illustrate operating characteristics of the SCR, and the Triac.
3. Demonstrate a solid state motor control.
4. Demonstrate an eddy current drive control.
5. Demonstrate the use of an oscilloscope.

G. Trouble Shooting

1. Motors

1. Demonstrate the following conditions:
 - (a) low voltage
 - (b) high voltage
 - (c) over loading
 - (d) blocked ventilation
 - (e) single phasing

H. Electric Welders

6 Hours

1. Welding Machines

1. Understand the principle of operation, including:
 - (a) transformer
 - (i) AC
 - (ii) AC/DC
 - (b) rotating
2. Demonstrate a knowledge of maintenance requirements.
3. Name the parts of any electric welder.

2. Welding

1. Explain the rationale of TIG welding as it applies to the trade.

I. Safety and Regulations

4 Hours

1. Explosion-proof Motors

1. Demonstrate an ability to locate and interpret sections of the CSA Standards, namely:
 - (a) C22.2 #30
 - (b) C22.2 #145

2. Gas Welding and Cutting (As a Tool of the Trade)

1. Explain the characteristics of oxygen and acetylene and know the recommended handling and storage methods for same.
2. Recognize the construction and function of regulators and hoses.
3. Demonstrate how to clean, store and take care of torch tips.
4. Select the attachments required for cutting and know the required safety precautions to be taken.
5. Explain the use of personal protective equipment required.

J. Methods of Three Phase Power Measurement**6 Hours**

1. Calculate power measurement:
 - (a) two wattmeter method
 - (b) three wattmeter method

K. Static and Dynamic Balancing**3 Hours**

1. Explain and demonstrate the ability to balance machines by either static or dynamic means.

L. Programmable Controllers**2 Hours**

1. Demonstrate a basic schematic to include:
 - (a) start-stop station

SUGGESTED REFERENCE MATERIALS

Direct Current Fundamentals — Loper — Delmar

Electric Motor Repair — Rosenberg — Holt, Rinehart and Winston

Electric Circuits and Machines — Lister — McGraw Hill

Electrical Motor Control — Alerich — Delmar

Preventive Maintenance of Electrical Equipment — Hubert — McGraw Hill

Canadian Electrical Code — Part I — C.S.A.

C22.2 Explosion Proof Enclosure #30 — C.S.A.

C22.2 Explosion Proof Motors and Generators #145 — C.S.A.

TECHNICAL TRAINING SCHOOLS

The Electrical Rewind Mechanic apprenticeship training program is offered by Alberta Manpower, Apprenticeship and Trade Certification. Staff and facilities for teaching the program are supplied by:

1. Southern Alberta Institute of Technology

LOCATION OF APPRENTICESHIP AND TRADE CERTIFICATION REGIONAL OFFICES

BONNYVILLE

CALGARY

EDMONTON

FORT McMURRAY

GRANDE PRAIRIE

HINTON

LETHBRIDGE

MEDICINE HAT

PEACE RIVER

RED DEER

VERMILION

GOVERNMENT OF THE PROVINCE OF ALBERTA

ALBERTA REGULATION 134/82

(Filed on March 25, 1982)

MANPOWER DEVELOPMENT ACT

MINISTERIAL ORDER

I, James D. Horsman, Minister of Advanced Education and Manpower, pursuant to sections 30(2) and 37(2) of the Manpower Development Act, hereby make the Regulation in the attached Appendix, being the Electrical Rewind Mechanic Trade Regulation.

DATED at Edmonton, Alberta, this 10th day of March, A.D., 1982.

JAMES D. HORSMAN
Minister of Advanced
Education and Manpower

A P P E N D I X

MANPOWER DEVELOPMENT ACT

Electrical Rewind Mechanic Trade Regulation

1(1) In this regulation

- (a) "electrical rewind mechanic" means a person engaged in the repair or rebuilding of electrical machines or equipment including their disconnection or reconnection to existing circuits;
- (b) "General Regulations" means the General Regulations under the Manpower Development Act, (Alta. Reg. 43/77);
- (c) "trade" means the trade of electrical rewind mechanic.

(2) The definitions in the General Regulations apply to this regulation.

PART 1

APPRENTICESHIP AND TRADE TRAINING

2 A person is eligible to be an apprentice electrical rewind mechanic if he satisfies the requirements of section 5 of the General Regulations, and either

- (a) has at least a grade 10 education, with Mathematics 10 or its equivalent, or
- (b) passes the entrance examination prescribed by the Board.

3(1) Subject to subsections (2), (3) and (4), an employer who is a journeyman or who employs a journeyman may employ one apprentice and one additional apprentice for each additional journeyman he employs.

(2) If the supply of journeymen in a location where an employer is carrying on business is insufficient to permit the employer to carry out his work commitments, the Director may authorize the employer to employ apprentices in addition to subsection (1).

(3) The Director may authorize an employer to employ an apprentice, in addition to those under subsections (1) and (2), on a temporary basis to train him in a branch of the trade not engaged in by the employer to whom he is apprenticed.

(4) For the purpose of subsections (1) and (2) an apprentice employed temporarily under subsection (3) shall not be considered to be an apprentice of his temporary employer.

4(1) The term of apprenticeship shall consist of 4 periods of 12 months each.

(2) Each period shall consist of not less than 1800 hours of employment, including time spent attending technical training courses prescribed by the Board.

(3) The Director may not, pursuant to section 25(1) of the Act, reduce the term of apprenticeship to be served by an apprentice to less than one period of apprenticeship.

5 When a contract of apprenticeship is registered with the Director, he shall issue to the apprentice an official record book referred to in section 14 of the General Regulations.

6(1) An apprentice shall not advance to the next period until the Director has authorized him to do so by making an entry in the apprentice's official record book under subsection (2).

(2) The Director shall make an entry in the apprentice's official record book authorizing advancement to the next period, when the apprentice

(a) has completed the previous period of apprenticeship,

(b) has received, in the opinion of the Director, a satisfactory report from

(i) his employer, and

(ii) the school at which he attended technical training courses prescribed by the Board,

(c) has completed the tests and examinations prescribed by the Board, and

(d) has attained passmarks prescribed by the Board in the tests and examinations referred to in clause (c).

7 The official record book of an apprentice shall be kept in the possession of his employer and on termination of the employment of the apprentice, the employer shall present the book to him.

8(1) An employer shall pay to an apprentice wages that are not less than the following percentages of the prevailing wages paid to a journeyman:

(a) 55% in the first period;

(b) 65% in the 2nd period;

(c) 75% in the 3rd period;

(d) 85% in the 4th period.

(2) Notwithstanding subsection (1), the wages paid to an apprentice shall not be less than the minimum wage fixed pursuant to the Employment Standards Act.

(3) An employer is not required to pay wages to an apprentice during the time the apprentice spends attending technical training courses prescribed by the Board.

9 The hours of work and working conditions of an apprentice shall be the same as those of a journeyman.

PART 2

CERTIFICATION

10 The Director may issue the following class of certificate for the trade in accordance with section 31(b) of the General Regulations

(a) Certificate of Qualification.

11 In accordance with section 32(b) of the General Regulations, the Director may issue a Certificate of Qualification, as appropriate, without examination, to a person who holds

(a) a Certificate of Completion of Apprenticeship issued by another province within Canada, or

(b) a Certificate of Qualification or a Certificate of Proficiency issued by another province within Canada bearing an Interprovincial Standards Red Seal.

12(1) An application to take an examination for a Certificate of Qualification shall be made to the Director.

(2) Documentary evidence acceptable to the Director shall be presented by an applicant for an examination setting out that the applicant:

(a) holds a certificate equivalent to an Alberta Certificate of Qualification issued by a provincial authority outside of Alberta, or

(b) has at least 5 years of acceptable work experience in the trade.

(3) The applicant shall provide translations into the English language acceptable to the Director, of credentials other than in English submitted pursuant to subsection (2).

13 A Certificate of Qualification issued under this regulation is effective unless cancelled or suspended by the Director in accordance with section 42 or 43 of the General Regulations.

14 Alberta Regulation 142/72 is repealed.



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